

Impact of Three Biological Decontamination Methods on Filtering Facepiece Respirator Fit, Smell, Comfort, and Donning Ease

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Objective

The objective of this study was to determine if ultraviolet germicidal irradiation (UVGI), moist heat incubation (MHI), or microwave generated steam (MGS) decontamination affect the fitting characteristics, smell, comfort, or donning ease of six N95 filtering facepiece respirator (FFR) models.

Introduction

- Concerns exist over a possible pandemic-induced shortage of disposable N95 FFRs. Although not currently recommended, N95 FFR decontamination and reuse should be studied as a possible mitigation strategy.
- Previous studies have shown that:
 - FFR models differ in construction, # of filter layers, water affinity (hydrophobicity), and strap composition / method of attachment.
 - Effects of decontamination on FFRs are model specific. FFRs react differently in terms of filtration degradation and physical changes (e.g., shrinkage, elasticity).
 - UVGI, MHI, and MGS inactivate MS2 bacteriophage (a surrogate for infectious virus) and H1N1 Influenza A deposited on the surface of the FFR and captured by the filter media, do not degrade N95 FFR filtration performance, and should pose no additional harm to the user.



Figure 1. A TSI Model 8020A PORTACOUNT® Plus with a TSI Model 8095 Companion™ accessory was used to measure respirator fit using a multi-donning protocol.

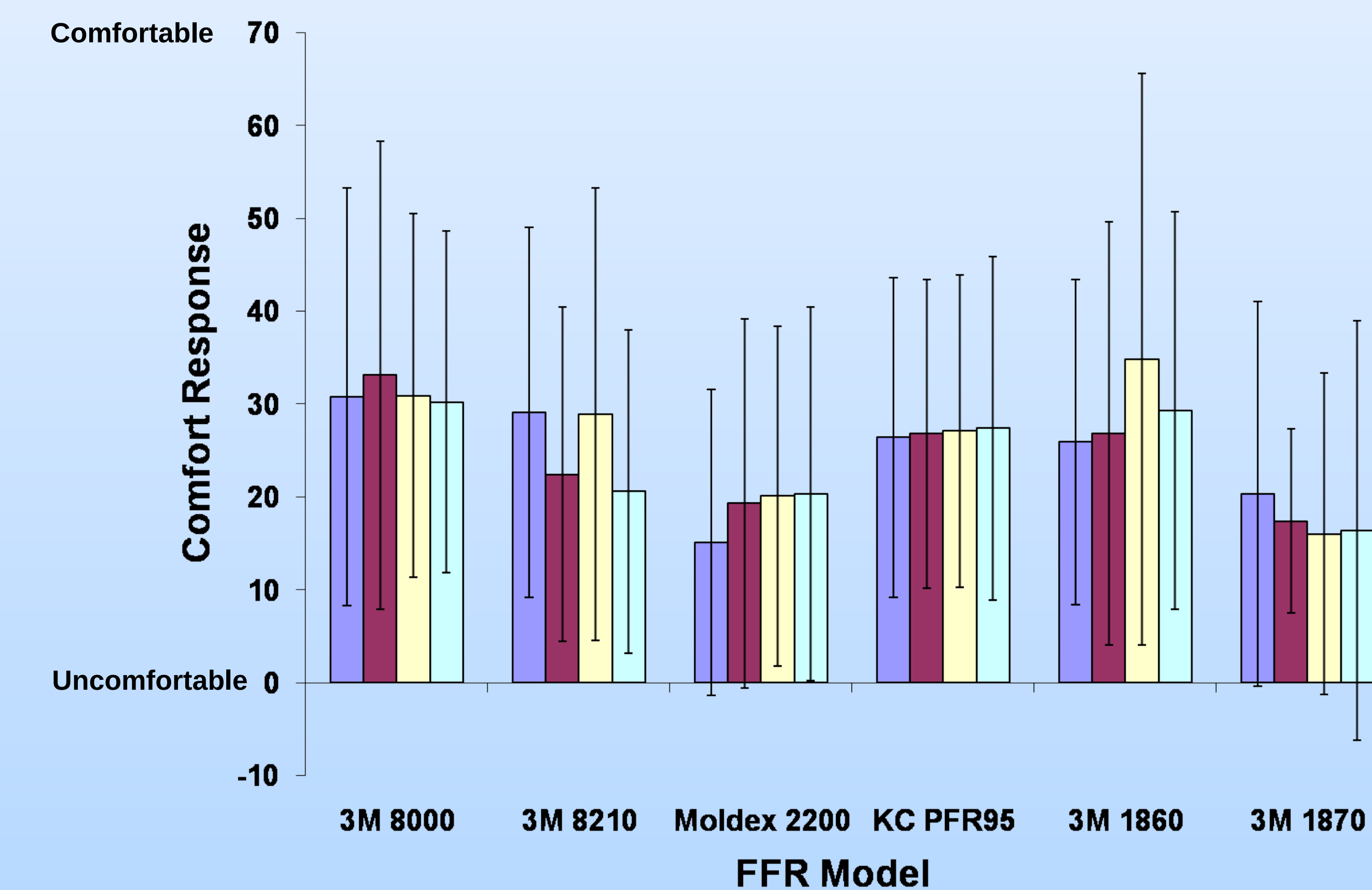
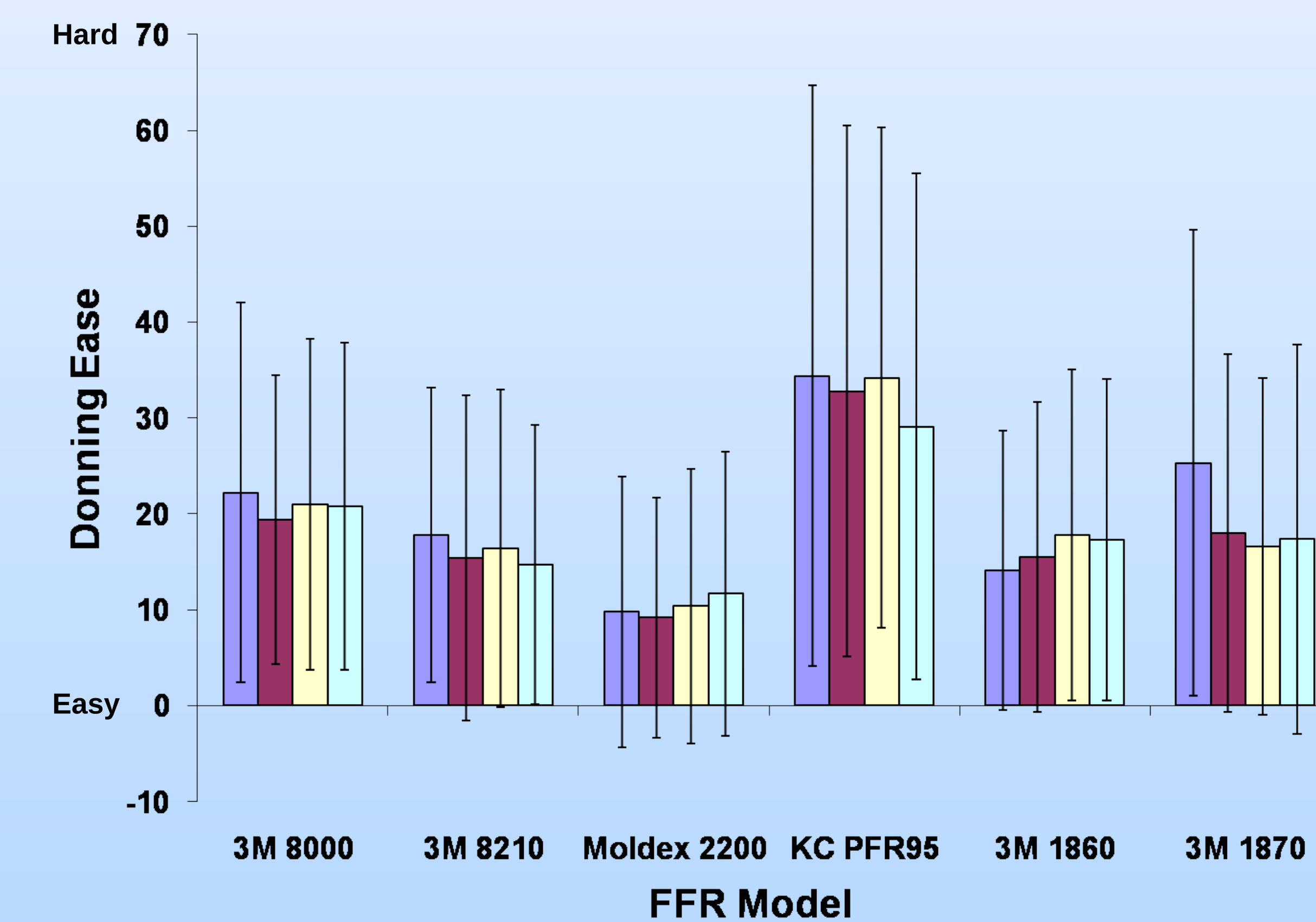
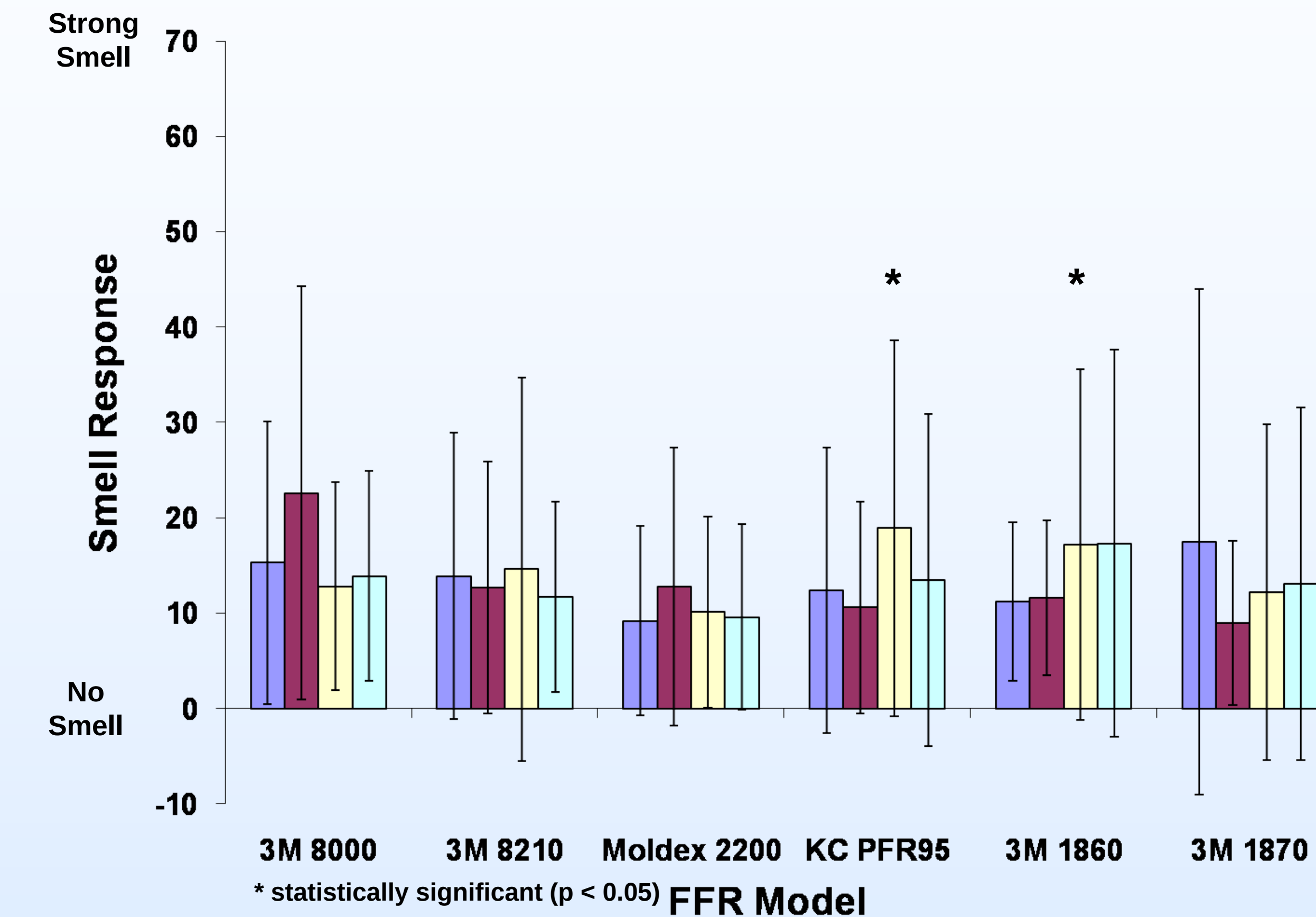
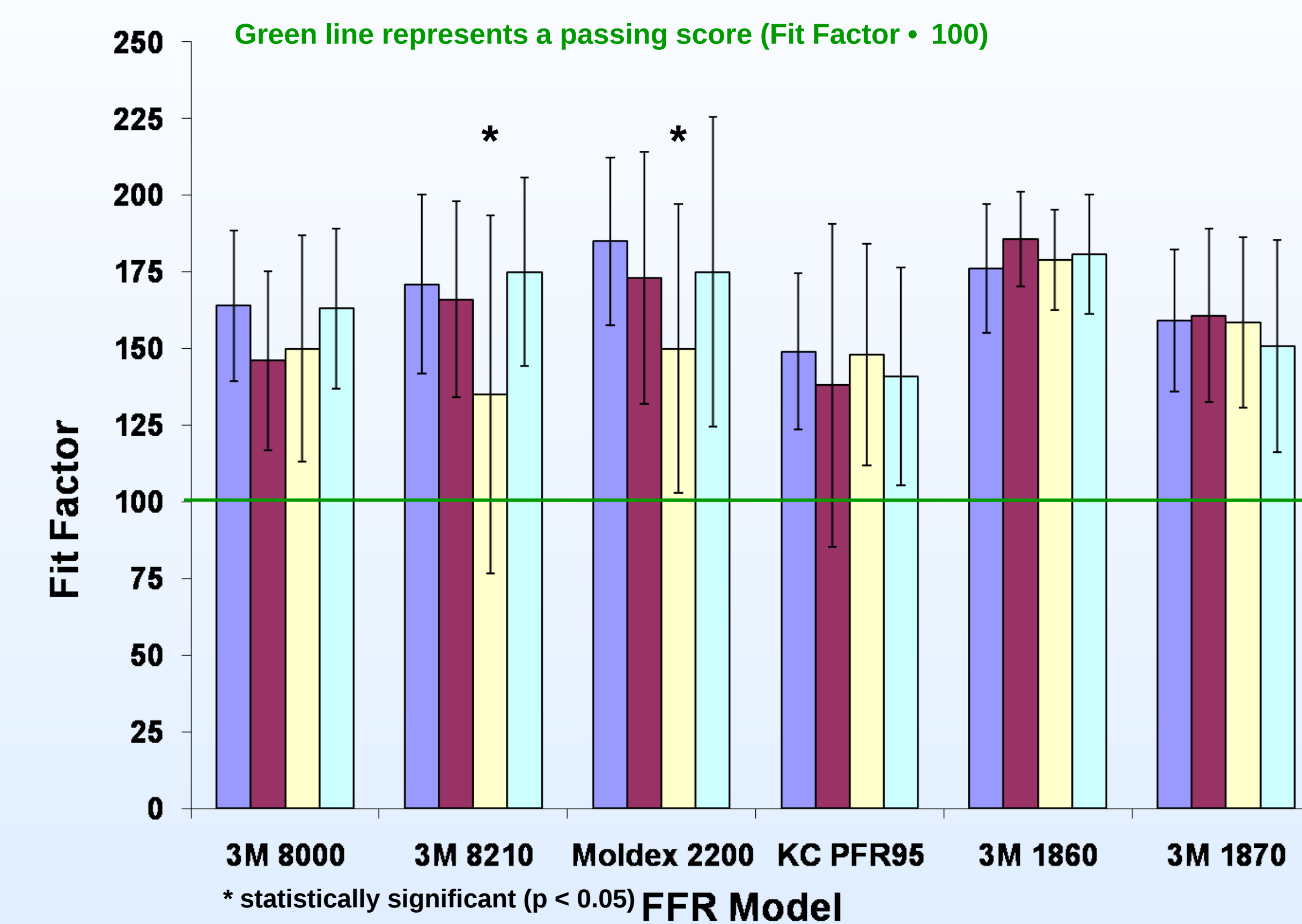
Methods

- Subjects qualified for the study by passing a standard quantitative fit test on new (untreated) FFRs. Recruitment continued until 10 subjects qualified on each model. Each model had a slightly different cohort of test subjects.
- Once qualified, respirator fit was measured (Fig. 1) with FFRs that were not decontaminated (controls) and with FFRs that had been decontaminated.
- Following fit testing, a visual analog scale survey was used to quantitatively capture the subjects' appraisals of smell (odor), comfort, and donning ease.
- Decontamination conditions: UVGI - 1.8 mW / cm² intensity (254 nm) for 15 min. per side, MHI - 60 °C, 80% RH for 30 min., MGS - 2 min. high setting in commercially available 1100 W Sharp microwave oven using 50 ml tap water in a centered box.
- The 6 FFR models were randomly chosen from those models available in the U.S. Strategic National Stockpile at the time of the study.
- Statistical *t*-tests were used to compare mean fit, smell, comfort, and donning ease values for each FFR and decontamination method against the respective controls for that model.

Study Limitations

- The findings are only applicable to the 6 FFR models and 3 decontamination treatments investigated.
- The study employed only a small group (n=10, per model) of experienced respirator test subjects. A group of less experienced FFR users may have yielded different results.
- Subjects were sedentary during fit testing, which only lasted ~ 30 minutes.
- A different cohort of subjects was used for each model, therefore the subjective results (smell response, comfort response, donning ease) are difficult to compare across models.

Results



Figures 2 - 5. (Top left to Bottom Right) Mean and Standard Deviation Fit Factor, Smell, Donning Ease, and Comfort for all 6 models and 3 decontamination methods across the 10 test subjects. The bars represent: Control (purple), UVGI (pink), MHI (yellow), MGS (cyan).

Conclusions

- Two FFR models demonstrated a statistically significant reduction in fit after MHI decontamination, while two different FFR models demonstrated a statistically significant increase in smell response after MHI decontamination; however, the numerical differences in both measures were quite small and the mean fit factors after MHI decontamination were still passing (> 135).
- Respirator users with characteristics similar to those in this study are unlikely to experience a large reduction in fit, increase in smell, discomfort, or increased difficulty in donning with these six FFR models after UVGI, MGS, or MHI decontamination.
- Further research is needed before the full impact of the decontamination methods are understood.

Disclaimer: The findings and conclusions in this poster have not been formally disseminated by the National Institute for Occupational Safety and Health and should not be construed to represent any agency determination or policy. **Acknowledgement:** Funding for this project was provided by the Technical Support Working Group (TSWG)